

4/ Claim rejection 35 USC 112

It is respectfully argued that the paper by Sherrit et al. (submitted with this response) which predates the patent application shows in Figure 11 a drill consisting of a horn in contact with a free mass located between the horn tip and the drill bit. It is our position respectfully that one skilled in the art of "Ultrasonic horns" would assume that the horn was connected to a solid or liquid for mechanical output. In addition and again respectfully "ultrasonic horns" are known by those skilled in the art as a vibration amplifier.

5/ "the horn tip" has been removed from the claim (see list of claims above)

6-7/ It is respectfully argued that the horn of Nakamura et al. (US Patent 5,896,460) is used to amplify sound in air. The media that the sound travels in a Nakamura horn is air. The Nakamura horn actually reflects the sound waves around the parallel air paths. In the present invention as outlined in the claims the media that the vibrations travel is a solid. The vibrations travel along the solid and as the cross sectional area of the solid is reduced the vibration amplitude increases. The rejection of claim 1 under 35 USC § 102 as anticipated by Nakamura et al. (US Patent 5,896,460) is therefore respectfully traversed. Because Nakamura et al. does not teach or suggests the use of a horn to concentrate mechanical vibrations onto a solid or liquid, claims 1-7, are not anticipated.

Regarding claims 2 and 6 Nakamura indeed shows the horn that is configured along the axis of extension of the speaker system, and an adjustable fold thickness is claimed however the extension is in air and the adjustable fold thickness does not control the bending motion of the folds as they do in the present invention.

Regarding claim 4 Nakamura shows a hemispherical stack of piezoelectric material that are used to generate sound directly by essentially pushing air. In the present invention as is described in the Patent application the piezoelectric stack drives vibrations into the solid horn input and the solid backing mechanism.

Regarding claim 5 Nakamura et al. indeed show a hollow core that stops at the piezoelectric hemisphere. In the present invention as described in the claims and shown in Figure 2. of the present patent the hole is through the entire device from front to back.

Regarding claims 7 Nakamura et al. shows a reflector (56, 58, 60, 62, 64) that is connected to the base of the horn to be folded as claimed however the reflectors are reflecting a sound wave in air rather than the sound wave in the solid-solid interface.

8/ Claim Rejection – 35 USC 103

The subject matter for the various claims is commonly owned and has been since invention. The inventions were conceived in a session with inputs from each of the joint inventors.

9/ The rejection of claim 3 under 35 USC § 103(a) as being unpatentable over Nakamura et al. (US Patent 5,896,460) is respectfully traversed. The Nakamura et al. patent does teach a stack of

piezoelectric elements as do a multitude of other patents however claim 3 also positions the stack to be external to the horn and concentric with it.

Response to Arguments

10/ We respectfully believe that the arguments do have merit based on

- a) The amplifying of the vibrations in the Nakamura et al. (US Patent 5,896,460) horn is in air or some other gas. In the present invention the amplification is in solid elements of the horn.
- b) The mechanical power output in the Nakamura et al. (US Patent 5,896,460) horn is in the form of a pressure wave in a gas. The mechanical output of the present invention is in the form of a vibration in a solid at the tip of the horn.
- c) With respect to claim 4 Nakamura et al. (US Patent 5,896,460) does teach the use of a piezoelectric stack however not one that is encircled by the horn as a compact modality of the actuator.
- d) With respect to claim 5 Nakamura et al. (US Patent 5,896,460) does show a hollow core but one that is not through the whole structure and there is no mention of passing materials through the actuator as there is in claim 5 of the present invention.
- e) With respect to claim 7 Nakamura et al. (US Patent 5,896,460) does teach the use of reflectors for sound waves in air or some other gas not for reflecting vibrations in solids.

11/ Modification of Figures 1, 2, 3 and 4

Figures 1, 2, 3 and 4 have been changed from shade figures to line figures for clarity. In FIG 1 a tool is connected to the prior art horn to show the delivery of mechanical energy.